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DEVICE FOR TESTING OF AIRCRAFT CONSTRUCTION STRUCTURES

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Currently, the quality of the aircraft structures joints is evaluated in a destructive way by the distribution size of holes in the technological sample. Therefore, the development of automated non-destructive testing (NDT) tools for the quality of aircraft structures joints after assembly makes this task very relevant [1, 2].

In NDT systems, scanning devices are an integral part that provides the process of monitoring large objects with a complex configuration [3, 4]. A large number of diverse scanners are used in practice. The most versatile scanners can have 5 or more degrees of freedom. However, please note that each degree of mobility complicates the design and significantly increases the cost of equipment.

Among the companies that develop scanning devices for NDT, one can mention the company from Great Britain, "Silverwing", which offers a family of scanning devices such as Scorpion. These devices can move along the vertical walls of ferromagnetic tanks and large-diameter pipes up to a distance of 50 m. They are used for ultrasonic scanning of walls in order to identify damaged areas [5].

The Danish company "Force Technology" offers an automated track scanner ATS-1, which is a multi-purpose XY - rack-and-pinion scanner that moves on special straight or curved guides to test bulky items: bent pipelines, propeller wings or wind generators, where it is mounted on suction cups in any spatial position [6].

The scanner of the company "Sonomatic Ltd" MAXIM carries out linear movements along 3 axes, and can also perform rotational movements around a given axis. In this case, both continuous and discrete scanning can be performed [7].

The proposed scanning device is used to deliver the primary transducer to the place of testing, which may be located on the wing of the aircraft or other hard-to-reach parts. The device circuit is developed on the Arduino platform (Arduino UNOR 3), which is built on the basis of two microcontrollers from Atmel corporation (ATMega 328) and is used to receive signals from analog and digital sensors and control various actuators and exchange information with a computer using various interfaces [8].

The Arduino platform simplifies the process of working with microcontrollers and has several advantages over other devices. The first is low cost. Secondly, the software for this platform runs on all the most common operating systems: Windows, Macintosh OS X, and Linux. Thirdly, a simple and understandable programming environment [9].

The proposed device contains a dual shield of stepper motors, which is made on two control boards L293D. In addition, it has on its board a shift register SN74HC565N, which ensures stable operation of the drive wheel sets. The

microcontroller provides the reception of signals via the Bluetooth system processes and feeds them into the shift register SN74HC565N. The shift register organizes the distribution of signals between the two L293D control boards, which provide power to the stepper motors. The proposed device has a high speed. The execution time of all operations is 0.2 seconds.

For experimental verification of the health of the proposed device efficiency, a layout was created and a temperature control system diagram was implemented. The DS18B20 digital thermometer was used as a temperature sensor, which provides temperature measurement with 12-bit resolution. The measured temperature range is from -5 °C to + 125 °C with an accuracy of ± 0.5 °C in the range from -20 °C to + 65 °C. The system voltage was monitored with a DSN-DVM-368 voltmeter.

The speed of the scanner depends on the task. When moving up an inclined surface, the voltage of the motors increases, and when moving in the opposite direction, i.e. down - the voltage decreases. Thus, the following speed range is programmed: upward movement - the speed corresponds to 255 conventional units, when moving downward - 115 units, when moving along a horizontal surface the speed is 185 units.

The proposed device can be used in NDT systems for rivets and bolts of aircraft structures. It is characterized by increased maneuverability, the ability to reach inaccessible places and overcome obstacles such as bends of the structure. The developed program for implementing the testing procedure algorithm controls the movement of the scanner, organizes a survey of sensors, provides digital output of information to the operator's display, as well as to a remote PC.

Keywords: non-destructive testing, scanning systems, control algorithms.

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